Chapter 2 (Particle Nature of Light)
PYQ [IIT-JAM]

$A_1 \rightarrow$ Photo Electric Effect

Q1. Light described by the equation $E = (90V/m)\left[\sin\left(6.28\times10^{15}s^{-1}\right)t + \sin\left(12.56\times10^{15}s^{-1}\right)t\right]$ is incident on a metal surface. The work function of the metal is $2.0eV$. Maximum kinetic energy of the photoelectrons will be,

(a) $2.14eV$ (b) $4.28eV$ (c) $6.28eV$ (d) $12.56eV$

IIT-JAM 2011

Q2. Electric field component of an electromagnetic radiation varies with time as, $E = a(\cos\omega_0 t + \sin\omega t\cos\omega_0 t)$, where a is a constant and the values of ω and ω_0 are $1\times10^{15}s^{-1}$ and $5\times10^{15}s^{-1}$ respectively. This radiation falls on a metal of work function $2eV$. The maximum kinetic energy (in eV) of photoelectrons is

(a) 0.64 (b) 1.30 (c) 1.70 (d) 1.95

IIT-JAM 2013

Q3. In a photoelectric effect experiment, ultraviolet light of wavelength 320 nm falls on the photocathode with work function of 2.1 eV. The stopping potential should be close to

(a) 1.8 V (b) 1.6 V (c) 2.2 V (d) 2.4V

IIT-JAM 2014

Q4. In photoelectric experiment both sodium (work function $= 2.3eV$) and tungsten (work function $= 4.5eV$) metals were illuminated by an ultraviolet light of same wavelength. If the stopping potential for tungsten is measured to be $1.8V$, the value of the stopping potential for sodium will be_______________V.

IIT-JAM 2016

Q5. In a photoelectric effect experiment, a monochromatic light source emitting photon with energy greater than the work function of the metal under test is used. If the power of the light source is doubled, which one of the following statements is correct?

(a) The number of emitted photoelectrons remains the same

(b) The stopping potential remains the same

(c) The number of emitted photoelectrons decreases

(d) The stopping potential doubles

IIT-JAM 2020

$B_1 \rightarrow$ **Compton Effect**

Q6. A photon of wavelength λ is incident on a free electron at rest and is scattered in the backward direction. The functional shift in its wavelength in terms of the Compton wavelength λc of the electron is,

(a) $\frac{\lambda_C}{2\lambda}$ (b) $\frac{2\lambda_C}{3\lambda}$ (c) $\frac{3\lambda_C}{2\lambda}$ (d) $\frac{2\lambda_C}{\lambda}$

IIT-JAM 2008

Q7. $X-$rays of wavelength $0.24\ nm$ are Compton scattered and the scattered beam is observed at an angle of 60° relative to the incident beam. The Compton wavelength of the electron is $0.00243\ nm$. The kinetic energy of scattered elections in eV is__________

IIT-JAM 2015

Q8. X-ray of $20\ keV$ energy is scattered inelastically from a carbon target. The kinetic energy transferred to the recoiling electron by photons scattered at 90^0 with respect to the incident beam is______________ keV. (Planck constant $= 6.6\times10^{-34}$ Js, Speed of light $=3\times10^8\ m/s$, electron mass = $9.1\times10^{-31}\ kg$. Electronic charge $=1.6\times10^{-19}C$)

IIT-JAM 2016

Q9. A photon of frequency ν strikes an electron of mass m initially at rest. After scattering at an angle ϕ, the photon loses half of its energy. If the electron recoils at an angle θ, which of the following is (are) true?

(a) $\cos\phi = \left(1-\frac{mc^2}{h\nu}\right)$ (b) $\sin\theta = \left(1-\frac{mc^2}{h\nu}\right)$

(c) The ratio of the magnitudes of momenta of the recoiled electron and scattered photon is $\frac{\sin\phi}{\sin\theta}$

(d) Change in photon wavelength is $\frac{h}{mc}(1-2\cos\phi)$

IIT-JAM 2017

Q10. For a proton to capture an electron to form a neutron and a neutrino (assumed massless), the electron must have some minimum energy. For such an electron the de-Broglie wavelength in pictometers is____________

(Specify your answer to two digits after the decimal point)

IIT-JAM 2017

Q11. A γ -ray photon emitted from a $^{137}\mathrm{Cs}$ source collides with an electron at rest. If the Compton shift of the photon is $3.25\times10^{-13}\ \mathrm{m}$, then the scattering angle is closets to (Planck's constant $h=6.626\times10^{-34}\ \mathrm{Js}$, electron mass $m_\theta=9.109\times10^{-31}\ \mathrm{kg}$ and velocity of light in free space $c=3\times10^{8}\ \mathrm{m/s}$)

(a) 45° (b) 60° (c) 30° (d) 90°

IIT-JAM 2019

Q12. In a Compton scattering experiment, the wavelength of incident X -rays is $0.500\overset{0}{\mathrm{A}}$. If the Compton wavelength λ_c is $0.024\overset{0}{\mathrm{A}}$, the value of the longest wavelength possible for the scattered X -ray is __________ $\overset{0}{\mathrm{A}}$ (specify up to 3 decimal places)

IIT-JAM 2020